and now for something completely different

- light from stars arrives as individual photons
- purely Poisson statistics for arrival times
- example: our Sun, viewed from 100 light-years away:
  - 0.6 meter telescope (Fick) would see 10^6 photons per second; i.e. arrival rate = 1 MHz
- telescope instrumentation:
  - nanosecond (1000 MHz) timing resolution
  - mostly nothing; a pulse every 1000 nanoseconds

can we do better?

Charlie Townes thought so back in 1961...

- push 10 photons through the door in 1 nanosecond... from 100 light years away!
- what amount of energy is required?
  - **10^{23} Joules**
- over a nanosecond this is a power output of
  - **10^{14} Watts**

Existence Proof: petawatt lasers today

- lasers developed for fusion studies reach 1 quadrillion watts
- laser pulses up to 1 ns (one billionth of a second) in duration
- Pointed at a star, they could outshine the sun for that nanosecond!

What about Optical SETI?

- Radio is cheap and easy with today's technology
- future technology will enable high-power optical transmitters
- optical communication networks between interplanetary and interstellar spacecraft is likely in the distant future
  - unintentional emission is therefore possible
- What does it take?
  - High powered directed lasers to produce the signal
  - a clear shot!

OSETI strategy

- 1 meter telescope, solar star at 100 light years
- photons arrive from a star about 1,000,000/second
- a pulsed petawatt laser could pump a few photons into the telescope in 1 nanosecond
- look for several photons arriving within 1/1000 of the 'average' arrival time of stellar photons

The power of numbers:

when the starlight hiccups

- average photon arrival rate - 1 million / second
  - 1000 nanoseconds between photons
- chance of two arriving within 1 nanosecond
  - once per night (the Princeton + Harvard way)
- chance of three arriving within 1 nanosecond
  - once per century (the Berkeley way)

• Equipment to do this is "cheap" and available

• Can be done easily on ordinary optical telescopes

The Lick/Berkeley System

- built by an undergraduate, with a little help

Shelley Wright at the telescope

OSETI, Iowa State Style...

- fast electronics are key for our gamma ray astronomers

- The 10-m Whipple Air Cherenkov Telescope

Current Project

with Frank Krennrich (ISU)
Stephane LeBohec (UofU)

- visit to Santa Cruz to compare notes with Lick folks
- prototype instrument underway
- plan to deploy one instrument at Fick observatory
- eventual deployment at larger facilities